Monitoring input-output ion budgets in subalpine watersheds of central Colorado

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Robert Stottlemyer is a Research Biogeochemist with the National Park Service / U.S. Geological Survey. In addition to long-term watershed research at the Fraser Experimental Forest, he maintains projects at Isle Royale National Park, Agashashok Watershed, Noatak National Preserve and the Calumet watershed in Michigan.

Louise O'Deen has worked as chemist and laboratory manager for the Rocky Mountain Research Station since 1989. She oversees water, plant and soil analyses for long-term monitoring and research at the Fraser Experimental Forest and a variety of national parks and conducts analyses for monitoring network of wilderness lakes on U.S.F.S. land in the western U.S.

Abstract

The Fraser Experimental Forest (FEF), located in the central Rocky Mountains of Colorado includes both subalpine and alpine ecosystems and ranges in elevation from 2,684 m to 3,905 m. The 9,300 ha research forest is drained by more than a dozen first or second-order streams that form part of the headwaters of the Colorado River. Watershed-level manipulations have been employed at FEF to investigate the effects of various forest canopy removal strategies on snow accumulation and stream discharge. Water chemistry and sediment load have been assessed in conjunction with snow and stream flow measurements. Two manipulated and untreated watershed pairs dating to the mid 1940s and 1980s provide a unique opportunity to study the biogeochemical processes controlling the water quality of pristine and recovering subalpine watersheds. Here we present input-output ion budgets for the dominant nutrient cation and anion species in order to evaluate patterns of nutrient retention and export during a 10-year period for the main watershed pair. In these high elevation watersheds, snowpack water equivalent controls stream discharge and nutrient export, so we address the relations between seasonal and annual stream flow and nutrient concentrations and volume-weighted loads. The precipitation chemistry at FEF is relatively pristine relative to most collection sites within Colorado and weekly monitoring has shown few long-term trends since the monitoring program was initiated. Watershed nutrient budgets from FEF therefore, provide valuable baseline conditions to help land managers and policy makers assess management manipulations and detect long-term climate change or anthropogenic influences on atmospheric deposition.